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(54) **ORGANIC LIGHT EMITTING DISPLAY DEVICE**

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(51) **Int. Cl.**

H01L 27/15	(2006.01)
H01L 29/161	(2006.01)
H01L 31/12	(2006.01)
H01L 31/153	(2006.01)
H01L 33/00	(2010.01)
H01L 51/00	(2006.01)

(52) **U.S. Cl.** **257/84**; 257/40; 257/80; 257/83; 257/233; 257/257; 257/290; 257/291; 257/292; 257/444; 257/462; 257/51.018; 257/E33.076; 313/506

(58) **Field of Classification Search** 257/444, 257/462, E33.076, E51.018, 40, 80, 83, 233, 257/257, 290–292; 313/506

See application file for complete search history.

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(57) **ABSTRACT**

An organic light emitting display device. The organic light emitting display device includes a substrate having a pixel region in which pixels are formed and a non-pixel region in which a light sensor is formed, an insulating film formed on the substrate, a first electrode formed on the insulating film and formed of a reflective material reflecting light, the first electrode being formed on the entire surface of the insulating film except for a region between the pixels and a region over the light sensor, a pixel defining film exposing a region of the first electrode and formed on the insulating film, an organic light emitting layer formed on the exposed region of the first electrode, and a second electrode formed on the organic light emitting layer. The first electrode is formed to have a greater area than that of the organic light emitting layer.

7 Claims, 1 Drawing Sheet

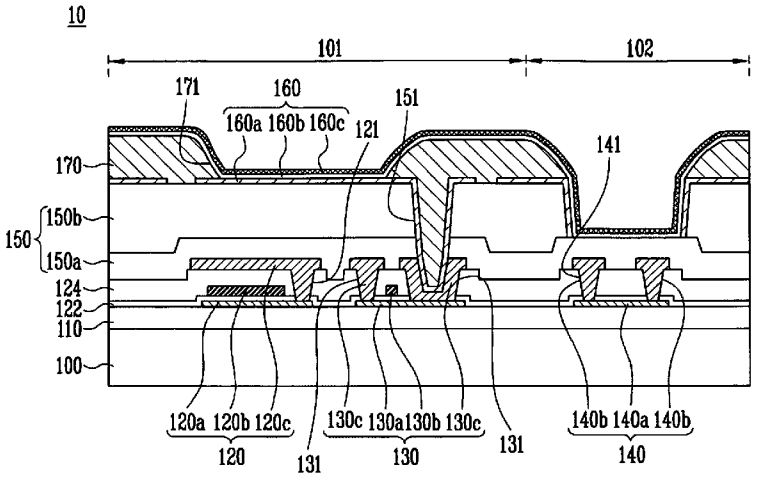

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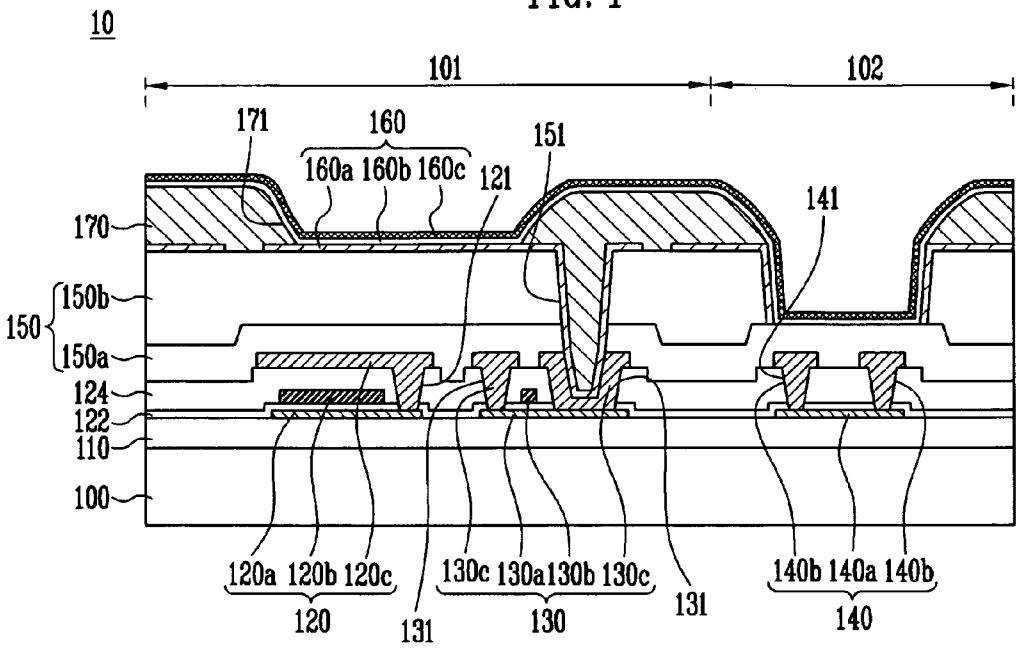
FIG. 1


10
101
102
171
160
160a 160b 160c
121
151
141
170
150
150b
150a
124
122
110
100
120a 120b 120c
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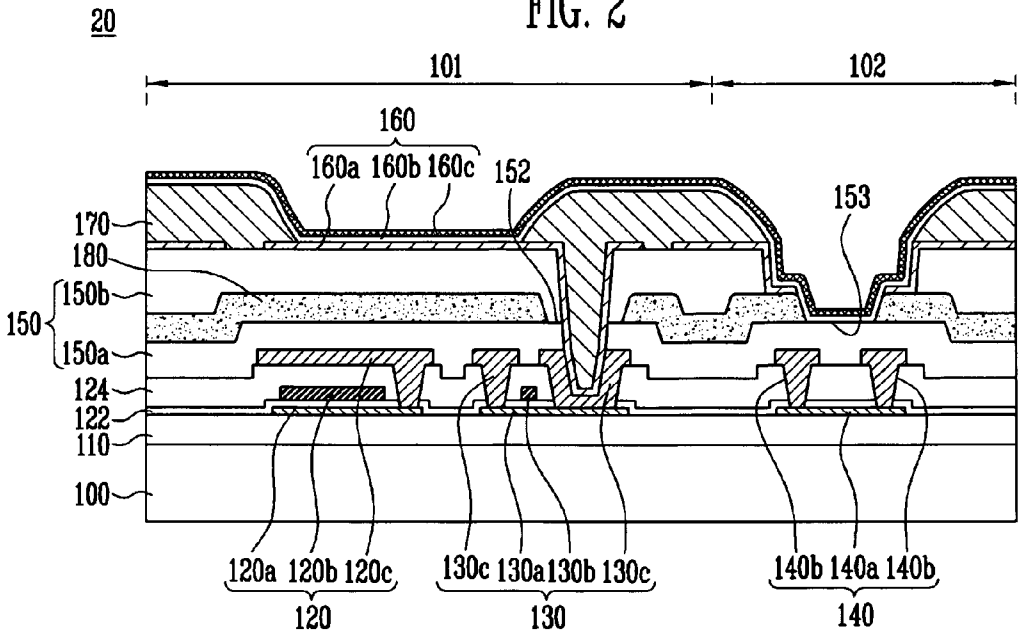
131
130c 130a 130b 130c
130
131
140b 140a 140b
140

FIG. 2


20
101
102
160
160a 160b 160c
152
153
170
180
150
150b
150a
124
122
110
100
120a 120b 120c
120
130c 130a 130b 130c
130
140b 140a 140b
140

ORGANIC LIGHT EMITTING DISPLAY DEVICE

CLAIM OF PRIORITY

This application makes reference to, incorporates into this specification the entire contents of, and claims all benefits all benefits accruing under 35 U.S.C. §119 from an application earlier filed in the Korean Intellectual Property Office on Oct. 29, 2008, and there duly assigned Serial No. 10-2008-0106358.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an organic light emitting display device, and more particularly to an organic light emitting display device having pixels of which operation reliability is secured by incident light.

2. Description of the Related Art

Recently, various flat panel display devices having reduced weight and volume as compared with cathode ray tube display devices, have been developed. Among others, an organic light emitting display device using organic compounds as light emitting materials has excellent brightness and color purity. As a result, the organic light emitting display device has been spotlighted as a next generation display device. Further, the organic light emitting display device is thin and light and is also able to be driven by using a relatively low power so that the organic light emitting display device has been expected to be useful in a portable display device or the like.

The portable display device is exposed to various external circumstances so that the visibility of a video image displayed by the portable display device may vary according to the various external circumstances, in particular, according to the external light illumination. In order to prevent this, there has been contrived a method to sense the intensity of the external light by having a light sensor disposed inside the portable display device and thus to control the brightness of a pixel unit.

Therefore, the organic light emitting display device used as a portable display device has a pixel unit allowing the brightness thereof to be controlled by the intensity of the external light. The pixel unit includes a pixel circuit having a transistor on a substrate and an organic light emitting diode receiving an electric current from the pixel circuit to emit light. A light sensor is formed in a region where the pixel circuit and the organic light emitting diode are not formed.

In the organic light emitting display device constructed as above, if an internal light, that is, the light generated by the organic light emitting diode, shines upon the pixel circuit, an electrical current may be undesirably generated by the internal light in the transistor or the like, and mal-function may occur.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide an improved organic light emitting display device.

It is another object to solve the above problems by providing an organic light emitting display device having pixels of which operation is stabilized by preventing the deterioration of operation reliability by incident light.

In order to accomplish the above object, according to a first aspect of the present invention, there is provided an organic light-emitting display device constructed with a substrate having a pixel region in which pixels are formed and a non-pixel region in which a light sensor is formed, an insulating film formed on the substrate, a first electrode formed of a reflective material reflecting light and disposed on the entire surface of the insulating film except for a region between the pixels and except for a region over the light sensor, a pixel defining film exposing a region of the first electrode and formed on the insulating film, an organic light emitting layer formed on the exposed region of the first electrode, and a second electrode formed on the organic light emitting layer. The area of the first electrode is formed to be larger than that of the organic light emitting layer.

Additionally, the insulating film of the organic light emitting display device may include a first planarization film that is an inorganic insulating film and a second planarization film that is an organic insulating film.

Additionally, the organic light emitting display device may further include a black matrix formed between the first planarization film and the second planarization film and exposing the light sensor.

Also, additionally, the first electrode may be formed of a material including Al or Ag.

Also, additionally, the black matrix is formed in a stacked structure including chrome and chrome oxide.

Also, additionally, the black matrix is formed in a stacked structure including molybdenum and molybdenum oxide.

With the present invention, external light incident to the organic light emitting display device and light generated from the light emitting layer are reflected so not to enter an element such as the TFT or the like to secure the operation reliability, making it possible to stabilize the operation of a pixel.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the invention, and many of the attendant advantages thereof, will be readily apparent as the same becomes better understood by reference to the following detailed description when considered in conjunction with the accompanying drawings in which like reference symbols indicate the same or similar components, wherein:

FIG. **1** is a cross-sectional view of an organic light-emitting display device constructed as a first embodiment according to the principles of the present invention; and

FIG. **2** is a cross-sectional view of an organic light-emitting display device constructed as a second embodiment according to the principles of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

In the following detailed description, only certain exemplary embodiments of the present invention have been shown and described, simply by way of illustration. As those skilled in the art would realize, the described embodiments may be modified in various different ways, all without departing from the spirit or scope of the present invention. Accordingly, the drawings and description are to be regarded as illustrative in nature and not restrictive. In addition, when an element is referred to as being "on" another element, that element can be directly on the another element or be indirectly on the another element with one or more intervening elements interposed therebetween. Also, when an element is referred to as being "connected to" another element, the element can be directly connected to the another element or be indirectly connected to the another element with one or more intervening elements interposed therebetween. Hereinafter, like reference numerals refer to like elements.

FIG. **1** is a cross-sectional view of an organic light-emitting display device constructed as a first embodiment according to the principles of the present invention. Referring to FIG. **1**, a substrate **100** of organic light emitting display device **10** includes a pixel region **101** in which pixels are formed and a non-pixel region **102**. More specifically, pixel region **101** includes a capacitor **120** and a thin film transistor (TFT) **130** that are driving devices and that are formed on a buffer layer **110** on substrate **100**, an insulating film **150** formed on capacitor **120** and TFT **130**, and an organic light emitting diode **160** formed on insulating film **150** and electrically connected to TFT **130** through a via-hole **151** formed on insulating film **150**. Non-pixel region **102** includes a light sensor **140** formed of photo diodes.

Herein, capacitor **120** is formed in a dual structure. Capacitor **120** includes a semiconductor layer **120***a*, a gate metal **120***b* and a source/drain metal **120***c*. Semiconductor layer **120***a* is formed on buffer layer **110**, and gate metal **120***b* is formed to overlap semiconductor layer **120***a*, with a gate insulating film **122** being interposed therebetween. Source/drain metal **120***c* is formed to overlap gate metal **120***b*, with an interlayer insulating film **124** being interposed therebetween, and is electrically connected to semiconductor layer **120***a* through a contact hole **121**. Semiconductor layer **120***a* of capacitor **120** may be formed simultaneously during the process of forming both a semiconductor layer **130***a* of TFT **130** and a semiconductor layer **140***a* of light sensor **140**. Gate metal **120***b* and source/drain metal **120***c* of capacitor **120** may be formed simultaneously during the processes of forming both a gate metal **130***b* and a source/drain metal **130***c* of TFT **130** and forming a source/drain metal **140***b* of light sensor **140**.

TFT **130** includes a semiconductor layer **130***a*, a gate metal **130***b* and a source/drain metal **130***c*. Semiconductor layer **130***a* is formed on buffer layer **110**, and gate metal **130***b* is formed on semiconductor layer **130***a*, with gate insulating film **122** being interposed therebetween. Source/drain metal **130***c* is formed on gate metal **130***b* having interlayer insulating film **124** therebetween and is electrically connected to semiconductor layer **130***a* through a contact hole **131**.

Light sensor **140** includes a semiconductor layer **140***a* and a source/drain metal **140***b*. Source/drain metal **140***b* is electrically connected to semiconductor layer **140***a* through a contact hole **141** having both of gate insulating film **122** and interlayer insulating film **124** disposed therebetween.

Insulating film **150** is formed on capacitor **120**, TFT **130** and light sensor **140**. Insulating film **150** may be formed in a multilayer structure including organic and inorganic insulating films. For example, insulating film **150** may include a first planarization film **150***a* which is an inorganic insulating film, and a second planarization film **150***b* which is an organic insulating film **150***b*.

A first electrode (for example, an anode electrode) **160***a* of organic light emitting diode **160** is electrically connected to thin film transistor **130** through via-hole formed **151** formed on insulating film **150**, and is formed on the top of insulating film **150**. First electrode **160***a* of organic light emitting diode **160** is formed of metal such as Al or Ag to reflect light. First electrode **160***a* of organic light emitting diode **160** is formed to have an area that is larger than that of a light emitting layer **160***b* of organic light emitting diode **160**. Accordingly, the light generated from light emitting layer **160***b* of organic light emitting diode **160** is reflected by first electrode **160***a* of organic light emitting diode **160**, so that the light will not enter TFT **130** or the like. The light generated from light emitting layer **160***b* of organic light emitting diode **160** does not enter light sensor **140**, either.

Owing to the reasons described above, the operation reliability of an element sensitive to light such as TFT **130** is secured, making it possible to stabilize the operation of the corresponding pixel. Only external light enters light sensor **140**, making it possible to precisely measure the intensity of the external light.

Organic light emitting layer **160***b* of organic light emitting diode **160** is formed on an exposed region of first electrode **160***a* and a pixel defining layer **170**. That is, pixel defining layer **170** is formed on first electrode **160***a* and is formed with an opening **171** to expose a region of first electrode **160***a*, and organic light emitting layer **160***b* of organic light emitting diode **160** is formed on the exposed region of first electrode **160***a*. Organic light emitting layer **160***b* may include various layers according to their functions. Organic light emitting layer **160***b* is generally formed in a multilayer structure including at least one of a hole injection layer (HIL), a hole transporting layer (HTL), a hole blocking layer (HBL), an electron transporting layer (ETL) and an electron injection layer (EIL), in addition to the light emitting layer. And the area of first electrode **160***a* is formed to be larger than the area of light emitting layer **160***b* of organic light emitting diode **160**, excepting the hole injection layer (HIL), the hole transporting layer (HTL), the hole blocking layer (HBL), the electron transporting layer (ETL) and the electron injection layer (EIL).

A second electrode (for example, a cathode electrode) **160***c* of the organic light emitting diode is formed across the entire substrate including organic light emitting layer **160***b* and first electrode **160***a*.

FIG. **2** is a cross-sectional view of an organic light-emitting display device constructed as a second embodiment according to the principles of the present invention. When describing FIG. **2**, the same constituents as shown in FIG. **1** will have the same reference numerals and the detailed description thereof will be omitted.

Referring to FIG. **2**, a black matrix **180** is further included in the organic light emitting display device of FIG. **1**. Black matrix **180** is formed between first planarization film **150***a* that is an inorganic insulating film and second planarization film **150***b* that is an organic insulating film.

More specifically, black matrix **180** is formed on first planarization film **150***a*, wherein black matrix **180** is not formed on region **152** where first electrode **160***a* of organic light emitting diode **160** and source/drain metal **130***c* of TFT **130** are electrically connected and region **153** where the external light is incident on light sensor **140**.

As described above, black matrix **180** is formed to cover driving devices **120** and **130** to block the external light from being reflected by driving devices **120** and **130**, thus making it possible to efficiently prevent deterioration of a contrast of the video image displayed by organic light emitting display device **20**. Also, in this case, not only the external light but also the light generated from organic light emitting layer **160** does not reach driving devices **120** and **130**. Therefore, the external light and the light generated from organic light emitting layer **160***b* is blocked by first electrode **160***a* of organic light emitting diode **160** primarily, and by black matrix **180** secondarily, thus making it possible to block light more efficiently. Accordingly, the operation reliability of the element which is sensitive to light, such as TFT **130**, is secured, thus making it possible to stabilize the operation of the pixel. Black matrix **180** is configured to have a stacked structure of chrome/chrome or a stacked structure of molybdenum/molybdenum.

While the present invention has been described in connection with certain exemplary embodiments, it is to be under-

stood that the invention is not limited to the disclosed embodiments, but, on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims, and equivalents thereof.

What is claimed is:

1. An organic light emitting display device, comprising:

a substrate having a pixel region in which pixels are formed and a non-pixel region in which a light sensor is formed;

an insulating film formed on the substrate;

a first electrode formed on the insulating film and formed of a reflective material reflecting light, the first electrode being formed on the entire surface of the insulating film except for a region between the pixels and a region over the light sensor;

a pixel defining film exposing a region of the first electrode and formed on the insulating film;

an organic light emitting layer formed on the exposed region of the first electrode; and

a second electrode formed on the organic light emitting layer, with the first electrode having a greater area than that of the organic light emitting layer.

2. The organic light emitting display device according to claim **1**, wherein the insulating film comprises a first planarization film that is an inorganic insulating film and a second planarization film that is an organic insulating film.

3. The organic light emitting display device according to claim **2**, further comprising:

a black matrix formed between the first planarization film and the second planarization film and exposing the light sensor.

4. The organic light emitting display device according to claim **1**, wherein the first electrode is formed of a material selected from a group of Al and Ag.

5. The organic light emitting display device according to claim **3**, wherein the black matrix is formed in a stacked structure comprising chrome and chrome oxide.

6. The organic light emitting display device according to claim **3**, wherein the black matrix is formed in a stacked structure comprising molybdenum and molybdenum oxide.

7. An organic light emitting display device, comprising:

a substrate having a pixel region in which pixels are formed and a non-pixel region in which a light sensor is formed;

an insulating film formed on the substrate;

a first electrode formed on the insulating film and formed of a reflective material reflecting light, the first electrode being formed on the entire surface of the insulating film except for a region between pixels and a region over the light sensor;

a pixel defining film exposing a region of the first electrode and formed on the insulating film;

an organic light emitting layer formed on the exposed region of the first electrode, with the first electrode having a greater area than that of the organic light emitting layer;

a second electrode formed on the organic light emitting layer; and

a black matrix formed between the first planarization film and the second planarization film and exposing the light sensor.

* * * * *